

Minimum economic production rate = 120

Fiscal Year	Administration's Plan		Accelerated Plan		Additional (Cost) or Savings
	Quantity	Cost	Quantity	Cost	
1988	42	1.7	54	2.0	(0.4)
1989	42	1.7	72	2.6	(0.9)
1990	42	1.8	108	3.8	(2.0)
1991	42	1.6	108	3.5	(1.8)
1992	<u>42</u>	<u>1.4</u>	—	—	<u>1.4</u>
1988-1992 Subtotal	210	8.2	342	11.9	(3.7)
1993	42	1.4			1.4
1994	42	1.4			1.4
1995	42	1.2			1.2
1996	<u>6</u>	<u>0.2</u>	—	—	<u>0.2</u>
Total 1988 to Completion	342	12.4	342	11.9	0.5

Net savings discounted at 2 percent = 0.1

F/A-18 Hornet

The F/A-18 is a dual-mission aircraft that replaces the A-7 and F-4 as a light attack aircraft and also as a highly maneuverable and survivable fighter. A new "C" model will be acquired beginning in 1988 with improved electronic countermeasures, avionics, and air-to-air attack capabilities. In 1990, a "D" model featuring all-weather attack capabilities will be introduced to meet Marine Corps requirements.

The Navy intends to acquire 580 additional F/A-18s at a rate, beginning in 1989, of 6 a month through 1995. (The proposed 1988 rate is 7 per month, the same rate the Congress has approved for the last five years.) The accelerated plan would up this rate to a maximum of 132 aircraft per year, thus completing the program three years earlier, as well as reducing its long-term cost by \$0.5 billion. This

alternative would, however, require the Congress to provide additional budget authority of \$4.5 billion over the period 1988-1992.

Maximum economic production rate = 145

Minimum economic production rate = 84

Fiscal Year	Administration's Plan		Accelerated Plan		Additional (Cost) or Savings
	Quantity	Cost	Quantity	Cost	
1988	84	2.6	84	2.6	(0.1)
1989	72	2.3	112	3.2	(1.0)
1990	72	2.0	120	3.0	(1.1)
1991	72	1.7	132	3.0	(1.3)
1992	<u>72</u>	<u>1.8</u>	<u>132</u>	<u>2.9</u>	<u>(1.1)</u>
1988-1992 Subtotal	372	10.3	580	14.7	(4.5)
1993	72	1.9			1.9
1994	72	1.7			1.7
1995	<u>64</u>	<u>1.4</u>	—	—	<u>1.4</u>
Total 1988 to Completion	580	15.3	580	14.7	0.5

Net savings discounted at 2 percent = 0.2

Harpoon Missile

The Harpoon missile is a medium-range (over 50 nautical miles) cruise missile designed to attack ships. It is produced in three versions--air-launched, surface-launched, and a submarine version ejected through a torpedo tube. The Harpoon is used by customers from 19 nations, in addition to the U.S. Navy.

The Navy plans to purchase 886 Harpoon missiles over the 1988-1992 period, an annual average of 177 missiles. Because of the extensive foreign military sales program for Harpoon, capacity exists to produce up to 660 missiles per year and additional Navy purchases could be made at significant savings. The accelerated plan calls for

the acquisition of 1,612 Harpoon missiles over the 1988-1992 period and would require \$0.6 billion in additional funding, relative to the Administration's 1988-1992 defense plan.

Maximum economic production rate = 660

Minimum economic production rate = 360

Fiscal Year	Administration's Plan		Accelerated Plan		Additional (Cost) or Savings
	Quantity	Cost	Quantity	Cost	
1988	124	0.2	204	0.2	a/
1989	138	0.1	268	0.3	(0.1)
1990	188	0.2	380	0.3	(0.2)
1991	181	0.2	380	0.3	(0.2)
1992	<u>255</u>	<u>0.2</u>	<u>380</u>	<u>0.3</u>	<u>(0.1)</u>
Total 1988 to Completion	886	0.8	1,612	1.5	(0.6)

a. Less than \$50 million in cost.

High-Speed Antiradiation Missile (HARM)

The HARM is an air-to-surface missile designed to home in on and destroy enemy radars. Plans call for the development of a new low-cost seeker version of HARM to be procured competitively. Both the Air Force and the Navy purchase the HARM. Combined procurement plans of the two military departments call for the purchase of 7,098 missiles over the 1988-1990 period at a total cost of \$1.7 billion.

The alternative plan would increase the average rate of HARM procurement from 2,366 per year to 3,240 per year over the 1988-1991 period, resulting in total purchases of 12,960 missiles, an 83 percent increase over the Administration's plan for 1988-1992. These additional missiles would add \$1.3 billion to the program's cost.

Maximum economic production rate = 6,480 (with two sources)
 Minimum economic production rate = 3,240

Fiscal Year	Administration's Plan		Accelerated Plan		Additional (Cost) or Savings
	Quantity	Cost	Quantity	Cost	
1988	2,514	0.6	3,240	0.8	(0.2)
1989	2,659	0.6	3,240	0.7	(0.1)
1990	1,925	0.4	3,240	0.7	(0.3)
1991	—	—	<u>3,240</u>	<u>0.7</u>	<u>(0.7)</u>
Total 1988 to Completion	7,098	1.7	12,960	3.0	(1.3)

Imaging Infrared (IIR) Maverick Missile

The IIR Maverick is an air-to-surface, imaging infrared guided missile for use against hard targets such as armored vehicles, fortifications, roads and railroads, and reinforced structures. The IIR version is superior to the earlier TV Maverick because it can be used both day and night. Both the Air Force and the Navy purchase the IIR Maverick. (The Navy's version--AGM-65F--uses a larger warhead and special algorithms for attacking ships.)

The Air Force plans to buy 15,900 Mavericks over the 1988-1992 period for a total cost of \$1.7 billion. Procurement will average about 3,200 per year over the 1988-1992 period. This represents a significant stretch-out of production compared with plans submitted with the 1987 budget request.

The alternative acquisition program would restore Maverick production rates to the levels envisioned in last year's program. Procurement for the Air Force would total 5,500 missiles in 1988 and average about 9,000 missiles in 1989 through 1993. This alternative plan would complete the Maverick program four years earlier and would save \$0.5 billion. Additional funding required over the 1988-1992 period would total \$1.5 billion.

Maximum economic production rate = 10,800
 Minimum economic production rate = 6,000

Fiscal Year	Administration's Plan		Accelerated Plan		Additional (Cost) or Savings
	Quantity	Cost	Quantity	Cost	
1988	2,100	0.4	5,500	0.6	(0.2)
1989	1,900	0.4	7,000	0.6	(0.3)
1990	2,700	0.3	7,000	0.5	(0.2)
1991	4,400	0.3	9,644	0.7	(0.4)
1992	<u>4,800</u>	<u>0.3</u>	<u>10,800</u>	<u>0.7</u>	<u>(0.4)</u>
1988-1992 Subtotal	15,900	1.7	39,944	3.2	(1.5)
1993	7,000	0.7	10,800	0.7	<u>a/</u>
1994	7,000	0.6			0.6
1995	7,000	0.5			0.5
1996	7,000	0.5			0.5
1997	<u>6,844</u>	<u>0.4</u>	<u> </u>	<u> </u>	<u>0.4</u>
Total 1988 to Completion	50,744	4.4	50,744	3.9	0.5

Net savings discounted at 2 percent = 0.3

a. Less than \$10 million in cost.

SH-60F Carrier Inner Zone Helicopter

The SH-60F helicopter will provide antisubmarine warfare protection in the inner zone of the carrier battle group. Other missions include anti-air warfare, command, communications, logistics, fleet support operations, and surveillance. The SH-60F is derived from the SH-60B helicopter that supports the Light Airborne Multipurpose System (LAMPS) Mark III. The Administration plans to buy 168 SH-60Fs at a rate of 12 to 24 a year, even though the aircraft manufacturer has the capacity to produce 60 a year.

The accelerated program would increase the production rate to a maximum of 40 per year, completing the program six years earlier and

saving \$0.2 billion. Additional budget authority necessary to fund the program over 1988-1992 would total \$1.0 billion.

Maximum economic production rate = 60 (for B and F models combined)

Minimum economic production rate = 24 (for B and F models combined)

Fiscal Year	Administration's Plan		Accelerated Plan		Additional (Cost) or Savings
	Quantity	Cost	Quantity	Cost	
1988	18	0.3	18	0.3	a/
1989	18	0.4	30	0.5	(0.2)
1990	18	0.3	40	0.6	(0.3)
1991	12	0.2	40	0.5	(0.3)
1992	<u>12</u>	<u>0.2</u>	<u>40</u>	<u>0.4</u>	<u>(0.2)</u>
1988-1992 Subtotal	78	1.4	168	2.3	(1.0)
1993	12	0.2			0.2
1994	12	0.2			0.2
1995	11	0.2			0.2
1996	24	0.3			0.3
1997	24	0.3			0.3
1998	<u>7</u>	<u>0.1</u>	—	—	<u>0.1</u>
Total 1988 to Completion	168	2.6	168	2.3	0.2

Net savings discounted at 2 percent = 0.1

a. Less than \$50 million in cost.

Standard Missile 2 (Extended Range)

The Standard Missile is replacing the Tartar and Terrier missiles as the basic surface-to-air weapon aboard Navy ships and has been produced since 1967. The newest Standard (designated Standard Missile 2) comes in two versions: a medium-range version with a range of more than 30 kilometers and an extended-range version, using a booster stage, with a range of over 100 kilometers.

The Navy plans to purchase 1,650 extended-range Standard Missiles over 1988-1992 at a cost of \$0.8 billion. The alternative plan would increase the production rate from 325 to a maximum of 480 per year, requiring additional funds of \$0.2 billion.

Maximum economic production rate = 480

Minimum economic production rate = 360

Fiscal Year	Administration's Plan		Accelerated Plan		Additional (Cost) or Savings
	Quantity	Cost	Quantity	Cost	
1988	350	0.2	400	0.2	a/
1989	325	0.2	480	0.2	(0.1)
1990	325	0.2	480	0.2	(0.1)
1991	325	0.2	480	0.2	(0.1)
1992	<u>325</u>	<u>0.2</u>	<u>480</u>	<u>0.2</u>	<u>(0.1)</u>
Total 1988 to Completion	1,650	0.8	2,320	1.1	(0.2)

a. Less than \$50 million in cost.

Stinger Missile

The Stinger is a shoulder-fired missile that can be used to destroy aircraft flying at low altitude. It is a short-range missile, guided to its target by heat emissions from the aircraft's engine(s), and is used to defend troops, equipment, and installations.

The Army plans to purchase 31,631 Stinger missiles over the 1988-1993 period. The total cost for these missiles is \$1.5 billion. The accelerated plan would increase the average annual production rate to 6,326, a 20 percent increase, and would complete the acquisition program for Stinger in 1992.

Maximum economic production rate = 11,520
 Minimum economic production rate = 1,800

Fiscal Year	Administration's Plan		Accelerated Plan		Additional (Cost) or Savings
	Quantity	Cost	Quantity	Cost	
1988	4,200	0.2	6,000	0.3	(0.1)
1989	5,000	0.2	6,000	0.3	<u>a/</u>
1990	5,000	0.3	6,000	0.3	<u>a/</u>
1991	5,000	0.3	6,800	0.3	(0.1)
1992	<u>6,000</u>	<u>0.3</u>	<u>6,831</u>	<u>0.3</u>	<u>a/</u>
1988-1992 Subtotal	25,200	1.2	31,631	1.5	(0.3)
1993	<u>6,431</u>	<u>0.3</u>	—	—	<u>0.3</u>
Total 1988 to Completion	31,631	1.5	31,631	1.5	<u>b/</u>
Net savings discounted at 2 percent = <u>b/</u>					

a. Less than \$50 million in cost.

b. Less than \$50 million in savings.

UH-60A Black Hawk Helicopter

The Black Hawk is the Army's primary utility helicopter and can be configured to carry troops, cargo, specialized electronic equipment (in its EH-60A version), or medical evacuees. The Army plans to cut the UH-60A's production rate from the recent value of about 96 per year (including derivatives) to 61 in 1988 and 72 in 1989 and 1990. The Black Hawk program would terminate after 1991, when the last 47 aircraft would be ordered. This would leave a gap between utility helicopter requirements and available units.

The alternative plan for Black Hawk procurement would increase the production rate to 120 per year and continue procurement through 1992. This would add 324 aircraft at an additional cost of \$1.4 billion through 1992.

Maximum economic production rate = 144

Minimum economic production rate = 96

Fiscal Year	Administration's Plan		Accelerated Plan		Additional (Cost) or Savings
	Quantity	Cost	Quantity	Cost	
1988	61	0.4	96	0.7	(0.2)
1989	72	0.5	120	0.8	(0.3)
1990	72	0.4	120	0.6	(0.2)
1991	47	0.2	120	0.4	(0.2)
1992	—	—	<u>120</u>	<u>0.4</u>	<u>(0.4)</u>
Total 1988 to Completion	252	1.4	576	2.9	(1.4)

M1A1 Abrams Tank

The M1A1 is the main battle tank for the Army. It possesses special armor, compartmentalized fuel and ammunition stowage, and greater speed and mobility for improved survivability. It is capable of operating under all climate and light conditions. The M1A1 mounts a 120 mm cannon (compared with 105 mm for the M1) and possesses improved nuclear, biological, and chemical defense capabilities.

The Army plans to purchase a total of 2,086 M1A1s over the 1988-1992 period, at an average annual rate of 417 units. Additional planned purchases for the Marine Corps will still leave M1 production far below its minimum economic rate of 720 units per year. The alternative plan would increase M1 procurement to an annual rate of 840 units over 1989-1992, resulting in 1,874 additional tanks and adding \$4.3 billion to procurement costs.

Maximum economic production rate = 1,080
 Minimum economic production rate = 720

Fiscal Year	Administration's Plan		Accelerated Plan		Additional (Cost) or Savings
	Quantity	Cost	Quantity	Cost	
1988	600	1.6	600	1.6	(0.1)
1989	534	1.4	840	2.0	(0.5)
1990	304	1.1	840	2.4	(1.2)
1991	331	1.2	840	2.4	(1.2)
1992	<u>317</u>	<u>1.2</u>	<u>840</u>	<u>2.5</u>	<u>(1.3)</u>
Total 1988 to Completion	2,086	6.6	3,960	10.8	(4.3)

Bradley Fighting Vehicle

The Bradley Fighting Vehicle (BFV) is a full-track, lightly armored fighting vehicle. It possesses a two-man turret that mounts a 25 mm automatic stabilized cannon, supported by the TOW antitank missile system and a 7.62 mm machine gun. The mobility of the BFV is comparable to that of the M1 tank.

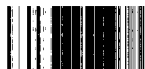
The Administration plans to purchase 2,549 fighting vehicles, ending in 1991. The annual procurement rate varies from 616 to 691 units. The accelerated plan would increase BFV production to its maximum economic rate of 792 vehicles per year and continue producing the fighting vehicle through 1992. This plan would provide 1,235 more vehicles by 1992 at an added cost of \$1.2 billion.

Maximum economic production rate = 792

Minimum economic production rate = 540

Fiscal Year	Administration's Plan		Accelerated Plan		Additional (Cost) or Savings
	Quantity	Cost	Quantity	Cost	
1988	616	0.7	616	0.8	a/
1989	618	0.7	792	0.8	a/
1990	624	0.7	792	0.9	(0.2)
1991	691	0.6	792	0.8	(0.2)
1992	—	—	792	0.8	(0.8)
Total 1988 to Completion	2,549	2.8	3,784	4.1	(1.2)

a. Less than \$50 million in cost.



APPENDIX B

SUPPLEMENTARY TABLES

These supplementary tables provide additional detail supporting findings discussed in the main text.

Table B-1 documents the historic decline in aircraft production rates. It shows that the time required to complete production of the first 200 tactical aircraft has been rising from about 20 months to as long as 58 months (in the case of the A-6). Production rates, once as high as 20 units per month (in peacetime), declined to around four to six per month for aircraft programs that began in the 1970s.

Even these rates look favorable when compared with current procurement trends. Several Navy aircraft, including the A-6E/F, C-2A, E-6A, and P-3C, were bought at average rates of less than one per month over the 1983-1987 period (see Table B-2). Overall, weapons procurement for that period shows little improvement over the earlier five-year period from 1976 through 1980.

Recent trends show that stretch-outs are increasing. Table B-3 lists the 20 largest weapons programs in the fiscal year 1988 defense budget request. (Ships are excluded by definition.) For 11 of these 20 programs, procurement quantities were reduced in 1988 below the estimate previously reported in the 1987 budget sub-missions. Only two systems--the AH-64 helicopter and the Tomahawk cruise missile--recorded an increase.

TABLE B-1. AIRCRAFT PRODUCTION RATES

Aircraft	Date First Production Aircraft Delivered (Month/Year)	Time to Produce 200 Aircraft (In months)	Monthly Production Rate (In units)
F-84B	6/47	10	20.0
F-86B	5/48	17	11.8
F-100A	10/53	21	9.5
A-4D	8/55	28	7.1
F-102A	6/55	19	10.5
F-106A	6/58	22	9.1
F-4H	12/60	22	9.1
A-6A	4/62	58	3.5
A-7A	3/66	22	9.1
F-111A	4/67	32	6.2
F-14A	5/72	50	4.0
F-15A	11/74	32	6.3
F-16A	8/78	29	6.9

SOURCE: G.K. Smith and E.T. Friedmann, *An Analysis of Weapon System Acquisition Intervals, Past and Present*, R-2605 (Santa Monica: The RAND Corporation, November 1980), Table D-1, p. 141.

TABLE B-2. COMPARISON OF PROCUREMENT RATES,
1983-1987 VERSUS 1976-1980

System	1983-1987 Average Annual Purchases	Comparable System	1976-1980 Average	Increase (Decrease) in 1983-1987
Army Systems				
Hellfire	6,131	Dragon <u>a/</u>	23,731	(17,600)
AH-64	117	AH-1T <u>a/</u>	61	56
M1	825	M-60 <u>a/</u>	694	131
Bradley	647	M113	962	(315)
Patriot	485	Hawk	472	13
Stinger <u>a/</u>	3,539	Stinger <u>a/</u>	2,366	1,173
TOW 2 <u>a/</u>	15,482	TOW 1 <u>a/</u>	14,465	1,017
Black Hawk	85	Black Hawk	64	21
Navy Systems				
Harpoon <u>a/</u>	284	Harpoon <u>a/</u>	234	50
HARM <u>a/</u>	1,460	Shrike	1,092	368
Phoenix	222	Phoenix	212	10
Standard Missile 2	848	Standard Missile 1	449	399
Sparrow <u>a/</u>	2,015	Sparrow <u>a/</u>	1,511	504
Sidewinder <u>a/</u>	2,122	Sidewinder <u>a/</u>	2,270	(148)
Harrier	34	A-7E	23	11
A-6E	8	A-6E	9	(1)
Tomahawk	186	ALCM	91	95
CH-53E	12	CH-53E	9	3
C-2A	8	UC-12B	22	(14)
EA-6B	9	EA-6B	6	3
E-2C	7	E-2C	6	1
E-6A	3	E-3A	4	(1)
F-14A	21	F-14A	38	(17)
F/A-18	84	A-7E	23	61
P-3C	8	P-3C	13	(5)
Air Force Systems				
AMRAAM <u>a/</u>	180	Sparrow <u>a/</u>	1,511	(1,331)
F-15D	41	F-15A/D	95	(54)
F-16	155	F-16A/B	152	13
GLCM	99	ALCM	91	8
KC-10A	9	KC-10A	3	6
MX	17	Trident I	78	(61)

SOURCE: Congressional Budget Office from Department of Defense data.

a. Joint service procurement.

TABLE B-3. PROCUREMENT CHANGES IN FISCAL
YEAR 1988 DoD BUDGET

System	1988 Funding Request (In millions of dollars)	1988 Quantity in 1987 Budget	1988 Quantity in Current Budget	Increase (Decrease)
F-16	2,758	216	180	(36)
F/A-18	2,458	132	84	(48)
Trident II Missile	2,198	66	66	0
F-15E	1,603	48	42	(6)
M1 Tank	1,538	840	600	(240)
MX	1,260	48	21	(27)
Tomahawk	916	410	475	65
Patriot	897	715	715	0
AMRAAM	875	833	630	(203)
F-14D	802	12	12	0
A-6F	782	12	12	0
Bradley Fighting Vehicle	709	870	616	(254)
AH-64	655	0	67	67
C-17	653	2	2	0
AV-8B	640	42	32	(10)
HARM	618	3,240	2,514	(726)
Standard Missile	583	1,250	1,150	(100)
MLRS	507	72,000	72,000	0
Phoenix	418	430	430	0
UH-60	396	85	61	(24)

SOURCE: Congressional Budget Office from Department of Defense, *Procurement Programs (P-1)*, 1987 and 1988.

APPENDIX C

A NOTE ON THE COST ESTIMATES USED IN THIS STUDY

At CBO's request, the services supplied estimates of unit cost at alternative procurement rates. These estimates were made for annual quantities ranging from 50 percent to 150 percent of a basic rate (typically, the proposed fiscal year 1988 procurement rate). These estimates were prepared in many cases with support from the manufacturers of the equipment.

Data for Army and Air Force systems used the procurement unit cost concept in reporting these estimates. Comparisons based on procurement unit cost may overstate rate effects because that concept includes certain costs for support items that are not always keyed to the annual procurement quantity. These support costs can be as much as half of the total funding request, the remainder being the actual cost of the weapon itself--its "flyaway cost."¹ The need for these support items depends on the size of the total program, not on its production rate, and they are sometimes purchased on a separate schedule keyed to activating units. Naturally, when these fixed costs for support are divided by a much smaller quantity, large increases in procurement unit cost can result.

For that reason, it is preferable to use flyaway cost whenever possible in analyzing production rate effects. Total cost estimates must include these support costs, however. For the cost estimates used in this study, support costs were assumed not to change as long as

1. The term "flyaway cost"--originating in aircraft production--is often used generically to refer to any weapons system. DoD Instruction 5000.33, *Uniform Budget/Cost Terms and Definitions*, defines flyaway cost as costs directly related to the creation of a usable end item of hardware, including government-furnished equipment, system/project management, test and evaluation, warranties, and first destination transportation. Only costs paid by procurement appropriations are included. Excluded from flyaway cost, but included in the broader procurement cost definition, are costs for training, peculiar support equipment, data, site activation, industrial facilities, and initial spare and repair parts (if paid for with procurement funds).

the total program quantity remained unchanged.^{2/} If the total quantity varied from the Administration's plan, support costs were adjusted proportionately.

Year-to-Year Comparisons May Overstate Rate Effects on Cost

Reductions in procurement are sometimes accompanied by very large changes in unit cost.^{3/} Some examples from DoD's fiscal year 1988 budget request illustrate this effect (see Table C-1). Procurement of the EA-6B aircraft was cut from 12 aircraft in 1987 to 6 in 1988 (a 50 percent decrease), with a 61 percent increase in unit cost. The E-2C aircraft procurement rate was reduced from 10 to 6 a year (a 40 percent decrease), and its unit cost rose 45 percent. In these cases, reductions in quantities purchased appear to be accompanied by more than proportional increases in unit cost.

Such year-to-year changes often tend to exaggerate the actual cost penalty associated with lower rates of procurement, however. In some cases, such as the A-6 aircraft in 1988, the reason for the increase may be a change to a more expensive, improved model. Even without major technical changes, inclusion of support costs in the cost concept, as discussed above, may bias the results upward.

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2. Some support costs, especially those for spare parts, might prove sensitive to the production rate.
 3. Unit cost is defined here as the budget cost of the weapons divided by their quantity. It excludes initial spares, but includes long-lead funding in prior years.

TABLE C-1. SELECTED PROGRAM CHANGES IN THE 1988
REQUEST FOR AIRCRAFT PROCUREMENT
(By fiscal year, in millions of dollars of
budget authority and percent)

Aircraft	1988 Request		Percent Change from 1987	
	Quantity	Dollars	Quantity	Unit Cost
Increases				
SH-60F Helicopter	18	330	157	-21
A-6E/F Aircraft	12	853	9	110
Decreases				
EA-6B Aircraft	6	357	-50	61
F-14A/D Aircraft	12	829	-20	56
E-2C Aircraft	6	427	-40	45
SH-60B Helicopter	6	144	-65	36
AV-8B Aircraft	32	700	-24	24
UH-60 Helicopter	61	480	-26	21
AH-64 Helicopter	67	746	-34	-5

SOURCE: Compiled by the Congressional Budget Office from data supplied by the Department of Defense.

